

Populationsbalanzen

UPPG 12

Mass balance:

$$\text{In} - \text{Out} + \text{Reaction} + \text{Grow} = \text{Accumulation}$$

$$\text{death rate}(\ddot{a}) = a \cdot \ddot{a}^2 - b \cdot \ddot{a} + c \quad (\text{year}^{-1})$$

$$n_{\text{in}} - n_{\text{out}} + n_L - n_{L+\Delta L} + n_{\text{born}} - n_{\text{dead}} = n_{\text{accumulation}}$$

$$n(t) = f(t, \ddot{a}) \cdot \Delta \ddot{a}$$

 \ddot{a} - age

$f(t, \ddot{a})$ - number of rabbits between $\ddot{a}, \ddot{a} + \Delta \ddot{a}$ at time t

$$1. \quad n(t, \ddot{a}) = n(t - \Delta t, \ddot{a} - \Delta \ddot{a})$$

$$2. \quad n_{\text{born}} = \text{known}$$

$$n_{\text{dead}} = \text{death rate} \cdot n(t, \ddot{a})$$

$$v = \frac{d\ddot{a}}{dt} = 1$$

t	dead
0	$D(0)$
1	$D(1)$
2	$D(2)$

$\frac{D(0)+D(1)}{2}$

$\frac{D(1)+D(2)}{2}$

average

$$\textcircled{1} \quad 0 - 0 + f(t, \ddot{a}) \cdot D \Big|_{\ddot{a}} \cdot \Delta t - f(t, \ddot{a}) \cdot D \Big|_{\ddot{a} + \Delta \ddot{a}} \Delta t + G \Delta \ddot{a} \Delta t =$$

number of rabbit get old
 from \ddot{a} to $\ddot{a} + \Delta \ddot{a}$ within
 time period Δt

$\epsilon = \text{born-dead}$
 $[\text{st/year}^2]$

$$= \frac{\partial n(t, \ddot{a})}{\partial t} \Delta t = \frac{\partial (f(t, \ddot{a}) \Delta \ddot{a})}{\partial t} \cdot \Delta t$$

$$\text{Fib}(t) = 1, 1, 2, 3, 5, 8, \dots$$

$$\text{Born} = 2 \cdot \text{Fib}(t) \cdot \delta(\ddot{a}=0), \quad \delta = \begin{cases} 1, & \ddot{a}=0 \\ 0, & \ddot{a} \neq 0 \end{cases}$$

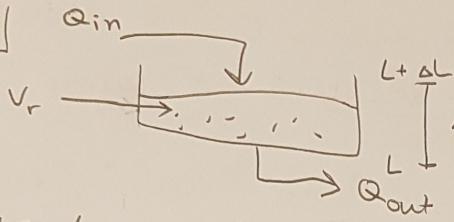
$$\text{Dead} = D(\ddot{a}) \cdot f(t, \ddot{a})$$

divide by Δt , $\Delta \dot{a} \rightarrow 0$

$$(1) \Rightarrow -\frac{\partial f(t, \dot{a})}{\partial \dot{a}} + G = \frac{\partial f(t, \dot{a})}{\partial t}$$

$$-\frac{\partial f(t, \dot{a})}{\partial \dot{a}} + \alpha F_{ib}(t) \cdot S(\dot{a}=0) - D(\dot{a}) \cdot f(t, \dot{a}) = \frac{\partial f(t, \dot{a})}{\partial t}$$

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V_r - Volume of reactor, m³
 D = crystal growth rate, m/s

Steady state!

$$n(t, L) = f(t, L) \cdot \Delta L$$

$$\begin{aligned} (1) \quad 0 &= (\alpha Q \cdot f(L)) \cdot \Delta L + f(L) \cdot \left. \frac{\partial f}{\partial L} \right|_L \cdot V_r - f(L) \cdot D \Big|_{L+\Delta L} \cdot V_r + \\ &+ \underbrace{G \cdot \Delta L \cdot V_r}_{\text{.. nucleation rate = born}} = 0 \end{aligned}$$

$f =$ dead = 0

$$(1) \Rightarrow -\alpha Q f(L) - V_r \cdot \frac{\partial (f(L) \cdot D)}{\partial L} + f \cdot V_r = 0$$